Wave/Energy Equation Problems

1. What is the wavelength of light that has a frequency of $1.20 \times 10^{13} s^{-1}$?

2. Ham radio operators often broadcast on the 6-meter band. The frequency of this electromagnetic radiation is _____ MHz.

3. What is the wavelength of light in nm that has a frequency of $3.22 \times 10^{14} s^{-1}$?

4. What is the wavelength of a photon that has an energy of $5.25 \times 10^{-19} J$?

5. The energy of a photon that has a wavelength of 12.3 nm is _____ J.

6. Suppose that a microwave oven uses photons with an energy of 1.42×10^{-23} joules to provide you with a cooked popcorn snack. Determine the wavelength and frequency of the microwaves.

7. The wavelength of the laser light that allows you to listen to your favorite tunes on a CD player lies in the red area of the visible spectra. If *one mole* of the photons delivers 1.54×10^{5} J, what is the frequency of this useful energy? Do people even still listen to CDs?

8. A mole of red photons of wavelength 725 nm has how many kJ of energy?

9. It takes 254 kJ/mol to eject electrons from a certain metal surface. What is the longest wavelength of light (nm) that can be used to eject electrons from the surface of this metal via the photoelectric effect?

10. If the metal used in problem 9 is hit with light with a frequency of 8.35×10^{14} hz, what will be the velocity of ejected electron?

11. If you dropped your textbook, you might claim that "it is difficult to hold on to waves" with some validity. After all, mass does possess wave-like properties. However, what would be the wavelength of a 855g textbook moving 9.8 m/s?

12. At what speed (m/s) must a 10 mg object be moving to have a de Broglie wavelength of 3.3×10^{-41} m?

13. The de Broglie wavelength of an electron is 8.7×10^{-11} m. The mass of an electron is 9.1×10^{-31} kg. What is the velocity of this electron? What is the frequency of this electron?

14. Diffraction is known to be a characteristic of waves. Yet, when electrons, with mass, pass through the openings in crystals a diffraction pattern appears. Which of the following is consistent with this information?

1. Diffraction patterns are caused as the waves exhibit destructive interference only. Electrons annihilate each other.
2. Electrons and EM radiation produce diffraction patterns meaning mass must have wavelike properties and waves must have mass.
3. Electrons can exhibit diffraction patterns because as they pass through the regular patterns of openings in crystals they get lodged in the crystal causing light to be emitted.
4. Mass and wavelength are directly related. The small mass of an electron allows it to have a small enough wavelength to cause diffraction

15. Our understanding of electromagnetic radiation (EM) played a critical role in our understanding of atomic structure. Compare red light, blue light, and x-rays and arrange them in order so that the <u>longest wavelength is first</u>, <u>highest frequency is second,</u> and finally <u>the highest energy is at the end of the list.</u>

1. X-ray; x-rays; x-rays
2. Red; x-rays; blue
3. Blue; x-rays; red
4. Red; x-rays; x-rays